Standard Operating Procedure

Leoni Plus Transport Ventilator: setup and usage

1. Scope

For use within the KIDS/NTS transport service operating within the Birmingham Women's and Children's NHS Foundation Trust.

2. Purpose

To provide safe, efficient and practical guidance for the use of the Leoni plus Transport ventilators in KIDS/NTS.

- This guideline identifies the key equipment and testing requirements needed to ensure that the neonatal transport ventilator is safe and fit for use before and after any transfers take place.

- The purpose of this document is to outline how to use the transport ventilator, the importance of a regular systematic checking procedure and a working knowledge of the equipment to ensure safe and effective transfers.

- This guideline must be followed by all team members who use the transport ventilator. This includes anyone who is involved with moving the equipment around the hospital and outside of the hospital grounds.

-

3. Definitions and abbreviations
4.

KIDS/NTS   Paediatric and Neonatal Transfer Service
CMV   Controlled Mandatory Ventilation
CPAP   Continuous Positive Airway Pressure
ΔP   Delta P, also known as amplitude
ET   Endotracheal
ETT   Endotracheal tube
FiO$_2$ Fraction of inspired oxygen
HFNC   High flow nasal cannula
HFO   High Frequency Oscillation
HIE   Hypoxic Ischaemic Encephalopathy
IMV   Intermittent Mandatory Ventilation
IPPV   Intermittent Positive Pressure Ventilation
IV   Invasive Ventilation
MAP   Mean Airway Pressure
nCPAP   Nasal Continuous Positive Airway Pressure

NIV	Non-Invasive Ventilation
O_2	Oxygen
Paw	Airway Pressure
PEEP	Positive End Expiratory Pressure
PIP	Peak Inspiratory Pressure
P_{Max}	Maximum Pressure (when using volume guarantee)
SIMV	Synchronised Intermittent Mandatory Ventilation
SIPPV	Synchronised Intermittent Positive Pressure Ventilation
Trig Vol	Trigger Volume
VG	Volume Guarantee
V_{min}	Minute Volume
Vt	Tidal Volume
Vte	Expired Tidal Volume

5. Introduction

- The Leoni plus transport ventilator is a Neonatal and Paediatric ventilator, certified for use within a transport setting. Within KIDS/NTS the ventilator will be used to deliver the following ventilation modes: SIMV (+/- VG), SIPPV (+/- VG), HFO, CPAP and HFNC.

- It has an internal rechargeable battery which provides up to 200 minutes operation in conventional ventilation modes and up to 60 minutes in HFO when no external electricity supply is available. It must be plugged in at all times when external electricity is available in order to keep the battery fully charged.

- A new complete disposable ventilator circuit should be connected at all times to ensure checks can be carried out appropriately and in case the team needs to dispatch urgently.

- Additional equipment needed to deliver non-invasive ventilation and HFO should be available for use. The ventilator needs to have a basic check performed before every shift and before a transfer; this includes calibrating the flow sensor and performing function tests.

- The whole ventilator should be cleaned with detergent wipes between patients; the expiratory valve, ventilator circuit and flow sensor are for single patient use and should be disposed of once no longer required.

6. Clinical Equipment

- Leoni plus Transport ventilator
- Clean test lung
- Fisher and Paykel humidifier
- Fisher and Paykel Infant Respiratory Care System (ventilator circuit)
- Single patient use flow sensor
- Single patient use expiratory valve
- 200ml bottle of sterile water
- Additional equipment for HFO: HFO connection tube set

- Additional equipment for HFNC: medin Nuflow nasal cannula set in appropriate size
- Additional equipment for nCPAP: NeoJet nCPAP Generator, nCPAP extension tube with pressure line, measuring tape, appropriately sized NeoJet mask/prongs, appropriately sized nCPAP hat

7. Setting up the Leoni plus Transport ventilator for clinical use

1. Use a clean Leoni plus Transport ventilator.

2. Ensure that the ventilator is connected to the medical air and oxygen wall supply.

3. Connect to the mains electricity when possible. The battery will last for up to 200 minutes in conventional ventilation modes and up to 60 minutes for high frequency oscillation.

4. Place the humidifier chamber onto the humidifier unit, remove the blue seals and lock into place. Switch on the humidifier after adding 100ml-200ml sterile water. Ensure the water level is not above the black fill line.

5. Connect the first section of the inspiratory limb (short blue tubing) between the inspiratory hose connection ('INSP') on the front of the Leoni plus Transport ventilator and the humidifier.

6. Connect the free end of the second section of the inspiratory limb (long blue tubing) to the humidifier.

7. A single patient use expiratory valve should be inserted (twist clockwise to lock) into the expiratory hose connection ('EXP') on the left-hand side of the ventilator. It should be oriented so that the side that is marked 'TOP' is inserted first. A filter is not required.

8. Connect the expiratory limb (white tubing) to the front of the expiratory valve.

9. The other connection for the patient circuit is the pressure sensing line, which will connect to the pressure hose connection ('Paw') on the front of the ventilator.

10. A flow sensor should be inserted between the ventilator circuit and the test lung. This comes in a separate sterile pack. Attach the flow sensor cable between the flow sensor and the back of the ventilator.

11. The humidification chamber wires also need to be connected. The heater wire has a 3 point 'clover end' which connects to the inspiratory limb (blue tubing) near the humidifier chamber. The 2 point end connects to the expiratory limb (white tubing) close to the expiratory valve.

12. Connect the humidifier temperature sensors into the inspiratory limb (blue tubing) with the 2 prong sensor closest to the humidifier and the single prong sensor closest to the baby.

13. Power on the ventilator by pushing and holding the green power button on the front. The system will run its self-tests then display a prompt for flow sensor calibration.

14. Ensure there is no gas flow through the sensor, either by occluding the circuit with a test lung or by removing the flow sensor from the circuit and occluding both ends of the flow sensor with a gloved finger and thumb. Press 'Calibrate' then 'Next' to start calibrating the flow sensor. Wait until the status changes to 'Done', press 'Close' to exit calibration then reconnect the flow sensor to the circuit if removed.

15. Go to the 'System test' screen. If there are any warnings, these will be indicated using a 'traffic light' system. Ensure a test lung is in situ then complete the function tests by pressing 'Start' then 'OK' to check the expiratory valve and to check for a leak in the circuit.

16. To access the Device Ready (Standby) screen, press 'Ventilation'.
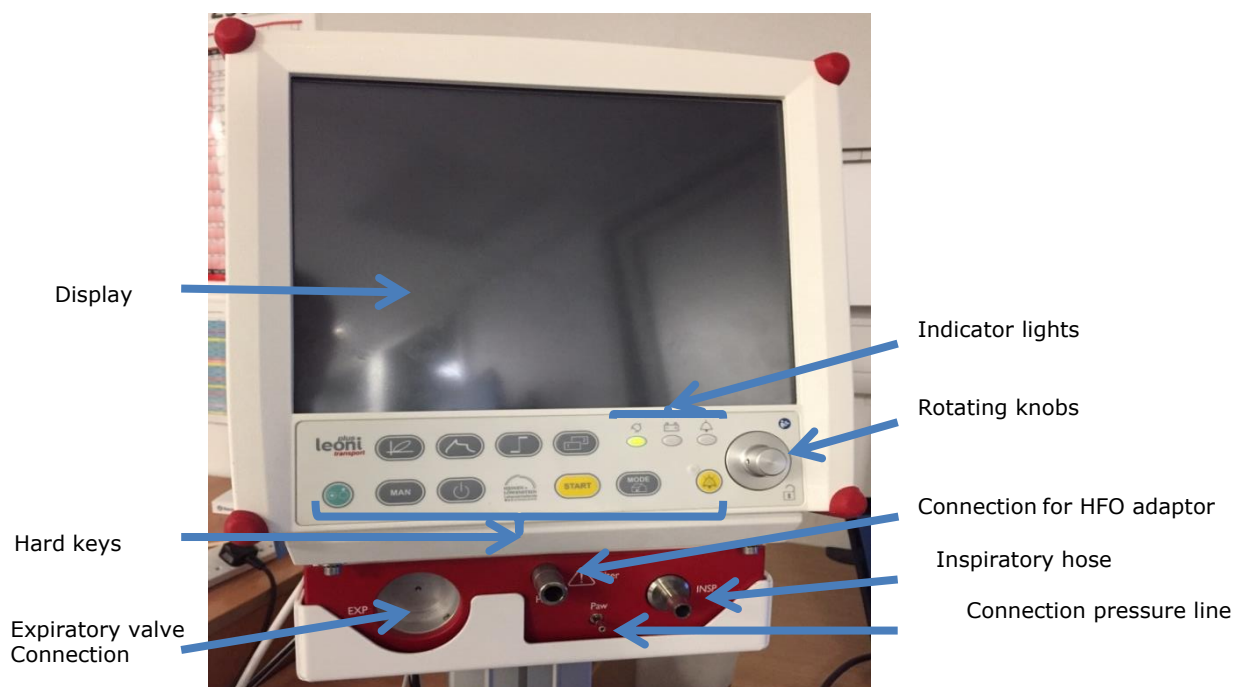
8. Starting and stopping invasive ventilation and adjusting ventilator settings

1. From the standby screen, select 'IV Invasive Ventilation'.

2. Select a ventilation mode: S-IPPV, S-IMV, CPAP or HFO.

Leoni plus Transport ventilators: setup and usage instructions Version 1; Aug 2019

3. Volume guarantee can be switched on/off after selecting the appropriate mode and set using the rotary knob. The tidal volume (V_t) required must be calculated by the operator and set in **ml** (not in ml/kg). Remember that when switching volume guarantee on/off the PIP/P_{Max} will not change automatically and will need to be adjusted to reflect either the peak pressure delivered with every breath (when not using VG) or the maximum pressure you would allow the ventilator to deliver (in volume guarantee).

4. Select starting parameters using a 'select and confirm' approach – all changes must be confirmed either by tapping the screen or using the rotary knob. If changes are not confirmed the ventilator will default back to the previous setting.

5. The trigger volume (Trig Vol) should be set at 15% as a default. If problems with excessive triggering are encountered en route due to excessive vibrations this may need to be increased to 20%.

6. Press the 'START' hard key to begin ventilation.

7. Changes can be made to the settings within the mode using the touch screen interface and the rotary knob. All changes must be confirmed before they will be implemented, otherwise the ventilator will revert to its previous settings.

8. To change between ventilator modes the new mode must be selected either on the touch screen or using the rotary knob and the change must be confirmed using the 'START' hard key.

9. To stop ventilation, press the green On/Off hard key on the front of the ventilator. You will then be prompted to choose either 'Continue', 'Standby/Trending' or 'Shutdown'.

10. If additional oxygen is required for a short period (e.g. whilst handling or suctioning the baby), the 'O_2 Flush' function can be used. This is located at the bottom right of the touchscreen. As a default, this will provide an additional 10% O_2 for 30 seconds (i.e. if the baby is on 35% O_2, 45% O_2 will be delivered for 30 seconds) then the ventilator will revert back to the baseline FiO_2. This function will activate without needing confirmation. If necessary, the FiO_2 increment and duration can be adjusted within the Toolbox screen on the ventilator.

11. Manual breaths can be delivered during ventilation if required. This effectively allows the baby to be 'bagged' without disconnecting the circuit. To do this, press the 'MAN' hard key on the front of the ventilator. The inspiratory phase of the breath will be delivered as long as the key is held. Multiple breaths can be delivered in this way. Remember that in volume guarantee modes the breath delivered will be at the P_{Max} and will not be volume limited, therefore the P_{Max} should be adjusted appropriately depending on chest movement and clinical response.

12. To power down the ventilator after use, press and hold the green On/Off hard key on the front of the ventilator then select 'Shutdown'.
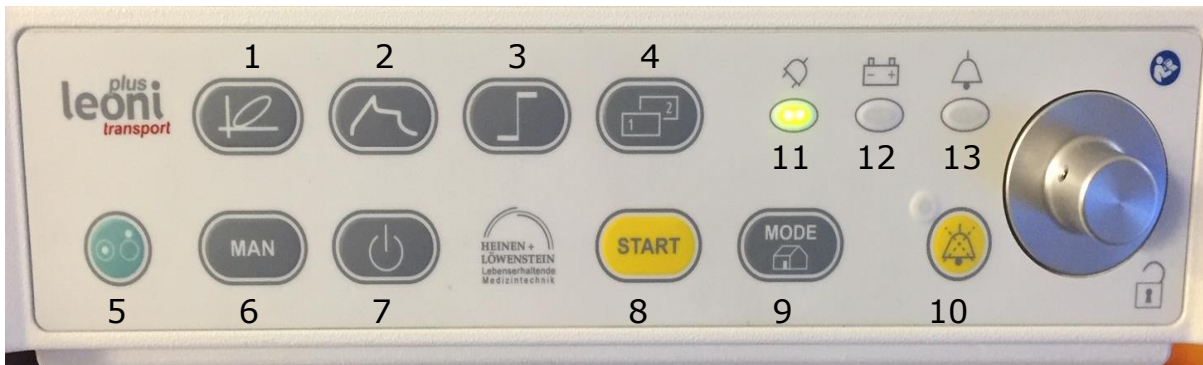
1) View loops
2) View curves
3) Alarm panel
4) Change between page one and page two of measured values
5) Power on/off
6) Deliver manual breath
7) Pause ventilation
8) START key
9) Change modes
10) Alarm silence
11) Mains power supply indicator
12) Battery power indicator
13) Alarm

Non-invasive ventilation

1. **For HFNC:** The circuit should be set up as for invasive ventilation but **without** the flow sensor in situ.

2. Select the appropriate size of Nuflow nasal cannula to fill 60-80% of the nares. The cannulae are colour coded by size:

   Small: Orange Medium: Red
   Large: Green Extra Large: Blue

3. Connect the cannula to the end of the circuit using the small white adapter piece included in the Nuflow packet.

4. Select 'NIV Non Invasive Ventilation'.

5. Select 'HiFlow H+L'.

6. Select the desired flow rate and FiO_2 using the touch screen and rotating knob to select and confirm. The P_{Max} should be set as 20mbar as a default.

7. Press the yellow 'START' hard key to begin ventilation.

8. The adhesive hydrocolloid stickers contained in the Nuflow packet can be used to secure the nasal cannula to the baby's cheeks.

9. **For CPAP:** The ventilator circuit should be set up as for invasive ventilation, but the **flow sensor is not required** when using nCPAP. The blue end of the nCPAP extension tube should be connected to the end of the ventilator circuit then the NeoJet generator attached to the other end of the extension tube.

10. The pressure line from the invasive ventilator circuit should be detached from the pressure hose connection at the front of the ventilator ('Paw') and capped.

11. The pressure line from the nCPAP generator should be connected to the blue end of the pressure line extension. The other end of the pressure line extension should be attached to the pressure hose connection at the front of the ventilator ('Paw')

12. The baby's head should be measured to select the correct hat size using the measuring tape provided. The hats are colour coded by size:

XX Small (17-19cm)	Green	Large (25.5-28cm)	Blue
X Small (19-21cm)	White	X Large (28-30cm)	Orange
Small (21-23cm)	Yellow	XX Large (30-33cm)	Green
Medium (23-25.5cm)	Red	XXX Large (33-36cm)	White

13. The correct size mask or prongs should be selected using the scale on the measuring tape. If the baby appears to fall between prong sizes, the manufacturer recommends choosing the larger sized prongs.

14. The mask or prongs should be attached to the nCPAP generator.

15. Select 'NIV Non Invasive Ventilation'.

16. Select 'Neojet H+L' then 'nCPAP'.

17. Adjust the PEEP and FiO_2 to the desired level using the rotating knob to select and confirm.

18. Press the yellow 'START' hard key to begin CPAP.

19. The Neojet device should be applied to the baby's face and secured to the hat using the Velcro tapes provided. The hat should be pulled down over the occiput and should cover the baby's ears. The triangular grey foam piece should be used to support the nCPAP generator and fixed to the front of the hat using the white velcro tabs. The tapes are used to hold the mask and can be fixed anywhere on the hat. The fixation should be tight enough to form a seal but should not need to be tightened excessively. The device has an inbuilt leak which is an important safety feature of the design and cannot be eliminated.

Correct positioning of nCPAP hat covering ears and occiput

9. High Frequency Oscillatory Ventilation

1. As the use of HFO will be relatively rare, particular care should be taken to set up the circuit correctly.

2. An adapter must be added into the circuit. The white end (with integrated filter) should be attached the 'HFO' connection on the front of the ventilator. The short clear flexible hose should be connected to the expiratory valve. Finally, the expiratory limb of the ventilator circuit should be connected to the clear, rigid plastic end of the adapter.

3. To start HFO from the standby screen select 'IV Invasive Ventilation' then select 'HFO'. To start from conventional ventilation, select the 'HFO' mode button.

4. Once HFO has been selected, adjust the ventilation parameters as required then press the yellow 'START' hard key to start HFO.

5. A safety prompt that the HFO adapter/filter is in situ and that the alarm volume will be set to maximum will appear and should be confirmed.

6. The ventilator parameters can be adjusted during HFO using the same select and confirm approach as with conventional ventilation.

## 10. Adjusting alarm limits and optimising the display

1. To adjust the alarm limits, press the button to open the alarm limits panel.

2. At the start of ventilation the 'Autoset' on can be used to set alarm limits but subsequent adjustments should be manually. To manually adjust an alarm limit, select the parameter to be adjusted within the alarm limits panel, use the rotating knob to select the appropriate value then press to confirm.

3. To close the alarm limits panel press the 'X' in the top right hand corner of the panel.

4. To silence an alarm, press and hold the yellow hard key with the bell icon on the front of the ventilator.

5. To change the number of waveforms visible on the display, touch the '# of charts' box on the bottom left of the screen just above the set parameters. Use the rotating knob to select the number of curves required and then press to confirm. As a default, it is recommended that 3 curves should be displayed (pressure, flow and volume) when using invasive ventilation whereas just one curve (pressure for nCPAP, flow for HFNC) is applicable with non-invasive ventilation.

6. It is possible to zoom in or out on a given curve by selecting the relevant curve then using the magnifying glass icon on the right hand side of the curve and the rotating knob to zoom in or out on the curve. The double ended vertical arrow icon '↕' can be used to move the curve up or down if required. To return to the original scale (to autoscale) press the open diamond symbol '◊'.

7. To adjust the time shown across the screen, use the box to the bottom right of the curves. Use the rotating knob to select and confirm the required time scale. This will be useful when changing between HFO and conventional ventilation.

Display Guide

1) Current mode
2) Current set parameters
3) Battery life/percentage and power
4) Alarm volume
5) Measured parameters
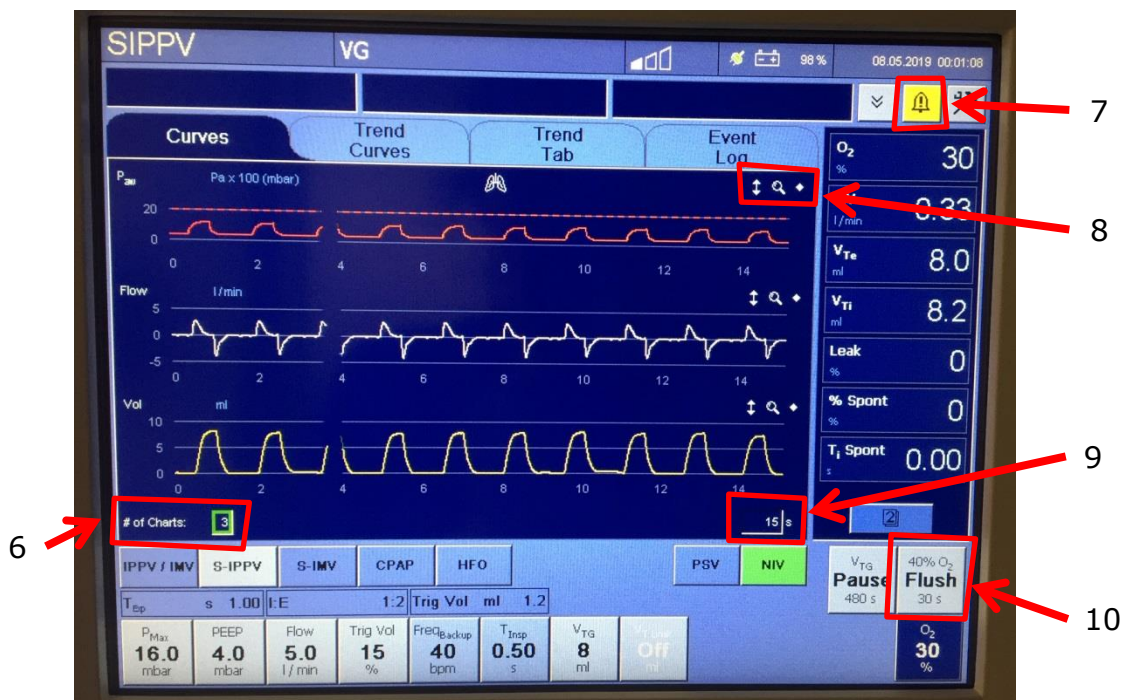
6) Number of curves being displayed
7) Alarm panel button
8) Icons (from left to right) to move curve up or down, to zoom in or out on curve and to autoscale
9) Time displayed across screen for curves
10) O$_2$ Flush

11. Monitoring compliance with and the effectiveness of this document

- There will be regular updates sessions to see trends and address concerns when the ventilators are in use.

- New doctors and nurses on the KIDS/NTS team will need to have their competencies assessed by an experienced clinician, and be signed off before using the Leoni plus Transport ventilator independently. The competency checklist is attached to the end of this guideline.

- The effectiveness of the document will be monitored by review of any reported incidents via the lead nurse for risk. These incidents will be shared with the team and consideration given to adjusting the guideline if concerns are identified.

12. Ventilation Modes

This is a brief overview of the ventilator modes that can be used on the Leoni plus Transport ventilator. For a more detailed explanation and advice on troubleshooting please refer to Chapter 7 of the Rosie handbook, in particular sections 7.2 to 7.3 (pages 94-105) http://merlin/Pages/Results.aspx?k=nicu%20handbook

Invasive Ventilation
SIPPV with VG – Synchronised Intermittent Positive Pressure Ventilation with Volume Guarantee.
In this mode the ventilator will attempt to synchronise its breaths with the baby's spontaneous breathing effort. Every breath taken by the baby will be supported by the ventilator. If the baby is making no/inadequate respiratory effort, the ventilator will deliver breaths at a set back-up rate. A tidal volume is set and the ventilator will deliver this volume with each breath. Most babies will require a tidal volume of 4-6ml/kg as a starting point. The maximum pressure delivered will vary from breath to breath, but in general should decrease if the baby is improving and vice versa. A P_{Max} is also set on the ventilator: if this pressure is exceeded the ventilator will terminate the breath even if the set tidal volume has not been achieved.
When this mode might be used: This should be the default mode of ventilation for most babies.

SIMV with VG – Synchronised Intermittent Mandatory Ventilation
As above, this is a synchronised mode of ventilation. However, in this mode the ventilator will only support a set number of breaths. Any additional spontaneous breaths the baby takes above the set rate will not be supported by the ventilator. Again, the ventilator will deliver a set tidal volume with each breath.
When this mode might be used: In babies who are intubated for airway protection who have relatively normal lungs (e.g. in HIE) and who are at risk of over-ventilation.

SIPPV – Synchronised Intermittent Positive Pressure Ventilation (without volume guarantee).
This is another synchronised mode. As with SIPPV with VG, every breath taken by the baby will be supported by the ventilator. If the baby is making no/inadequate respiratory effort, the ventilator will deliver breaths at a set back-up rate. However in this mode a peak pressure is set, and the ventilator will deliver a set pressure with each breath. The volume delivered will be variable depending on lung compliance.
When this mode might be used: Volume guarantee should be used if possible. However if there is a large leak around the ETT making this unfeasible and you would otherwise use SIPPV with VG, a second choice would be SIPPV.

SIMV – Synchronised Intermittent Mandatory Ventilation (without volume guarantee).
This is a synchronised mode in which the ventilator will only support a set number of breaths. Any additional spontaneous breaths will not be supported. In this mode a peak pressure is set and the ventilator will deliver a set pressure with each breath. The volume delivered will be variable depending on lung compliance.
When this mode might be used: Volume guarantee should be used if possible. However if there is a large leak around the ETT making this unfeasible and you would otherwise use SIMV with VG, a second choice would be SIMV.

HFO – High Frequency Oscillation.
A detailed description of the mechanism of HFO is beyond the scope of this guideline. The user sets a mean airway pressure (MAP), how great the pressure fluctuations around the MAP should be (the amplitude or ΔP) and how quickly the pressure should fluctuate (the frequency).
When this mode might be used: HFO might be considered in cases where conventional ventilation has been considered unsuccessful or where very high peak inspiratory pressures/mean airway pressures are required. This should be a consultant decision.

A note about CMV (Continuous Mandatory Ventilation)
The previous ventilator used by the KIDS/NTS team delivered CMV (also known as IPPV/IMV) as its primary mode. This is an unsynchronised mode whereby the ventilator delivers breaths with a set pressure (PIP) at a set rate, regardless of the effort made by the baby. It does not confer any advantages over the modes above and there should not be a reason to use it. In a baby who is not making any spontaneous respiratory effort, the synchronised modes will deliver the set (or back-up) rate.

Non-Invasive Ventilation

nCPAP – Nasal Continuous Positive Airway Pressure
A continuous positive airway pressure (PEEP) is delivered at the level set by the user.

HFNC (a.k.a. Hi Flow)
The ventilator delivers a continuous flow of heated, humidified gas at a set rate and oxygen concentration.

13.   References

Rosie Handbook Chapter 7, in particular sections 7.2 to 7.3 (pages 94-105)
http://merlin/Pages/Results.aspx?k=nicu%20handbook

'Leoni plus ventilator for neonatal and paediatric patients' training compendium.

Medical Devices Competency Statement

1. Leoni plus Transport ventilator

Risk Category of the device: High

Name of user:	
Job Title	
Ward/Department:	
Directorate:	
Assessor:	

Objective:

The user will demonstrate competence in the safe operation of the above device without assistance or supervision.

This assessment is based on the use of this device, not the interpretation of results, it is expected that the user will have the knowledge and skills to handle correctly and safely.

Any doubts with regards to handling the device please consult the operating instructions via the Medical Devices Portal or the ward based trainer.

To demonstrate competence, the user must achieve all the stated criteria, failure to do so will require the user to agree an action plan with the assessor or Ward Manager to be completed within an acceptable timeframe.

Competent users will be added to– Medical Devices or Ward Manager/Deputy.

	Is the user safe to use the device, can they?	**Competent** Yes/No	**N/A** Not applicable
1.	Perform hand hygiene according to Trust policy.		
2.	Describe purpose, operation and function of the ventilator.		
3.	Connect Air/O_2 and power. Discuss 'on' and 'standby' modes.		
4.	**Flow sensor & cable** Demonstrate how to: - Connect flow sensor & cable to the ventilator. - Calibrate flow sensor. - Connect and disconnect from the patient circuit. Describe how to dispose of the flow sensor after use		
5.	**Expiration Block** Demonstrate how to check and correctly insert expiratory valve (single patient use and reusable) Describe when to use a single patient expiratory valve and when to use a reusable expiratory valve Describe the cleaning process for the reusable expiratory valve		
6.	**Ventilation Circuit** Demonstrate: - Attaching circuit to ventilator - Attaching humidifier and connectors - Attaching proximal airway/pressure line - How to set up the circuit for conventional invasive ventilation		
7.	**Baseline checks** Describe when self test and function tests should be performed Describe how to access system test screen and how to interpret		

	current results (using red/yellow/green traffic lights) Demonstrate how to perform function tests		
8.	**Invasive Ventilation** Demonstrate: • How to select/change ventilation mode: S-IPPV, S-IMV • How to adjust ventilator parameters • How to start ventilation • How to deliver manual breaths • How to give an O_2 flush • How to put the ventilator into standby mode		

9.	**Volume Guaranteed Ventilation**
	• Identify ml/kg range for patient group.
	• Demonstrate how to:
	  o Turn volume guarantee on.
	  o Set appropriate Vt.
	  o Set appropriate P_{Max}.
	  o Record set and measured values.
	  o Adjust Vmin/Vte Alarms
	  o Turn volume guarantee off
	• Show adjustments needed when VG is turned off.		

9.	**High Frequency Oscillation** Demonstrate: • How to set up the circuit to deliver HFO, including the necessary adapter in the circuit • How to start HFO • How to set and adjust the ventilatory parameters • How to optimise the display screen for HFO • How to change back to conventional ventilation		
10.	**Alarm Panel** Demonstrate: • How to access the alarm window • How to autoset the alarm limits • How to manually adjust alarm limits • How to silence the alarm • How to review the alarm history • How to adjust the alarm volume		
11.	**Display Options** Demonstrate how to: • Change the number of curves displayed • Adjust the size of the curves and move curves up or down • How to autoscale curves • How to change the time shown across the display • How to access the trends window • How to access loops		
13.	**nCPAP** Demonstrate • How to set up the circuit for nCPAP • How to start nCPAP and adjust the pressures delivered Discuss • How to select the appropriate size CPAP hat • How to select the appropriate size mask/prongs • How to secure the device to the baby		
14.	**HFNC** Demonstrate: • How to set up the circuit for HFNC • How to start HFNC and adjust the flow		

Leoni plus Transport ventilators: setup and usage instructions Version 1; Aug 2019

	Discuss how to select the appropriate size of nasal cannula and how this should be secured to the baby		
15.	Demonstrate how to turn ventilator off.		
16.	**Battery Power** Discuss the operating time of the battery What is the battery charging time?		
17.	Discuss what to do in the event of a battery/ventilator failure		
18.	Describe how to clean the ventilator.		

Competency Statement

_____ is assessed as competent/not competent* to use the aforementioned device.

Signed: _____   Assessor: _____   Date: _____

Signed: _____   User: _____   Date: _____

*Delete as applicable. If the user is assessed as not competent an action plan needs to be outlined below and agreed.

Action Plan

Criteria Number	Assessment Criteria in which the user was not competent	Actions to address competence	By whom	Date

The above action plan has been agreed between the Assessor and user to address areas of competence.

Signed: _____   Assessor: _____   Date: _____

Signed: _____   User: _____   Date: _____

One copy of the completed competency assessment form should be held in the staff personnel record and one copy given to the employee for their KSF portfolio.

Equality and diversity statement

This document complies with the Birmingham Women's and Children's NHS Foundation Trust service equality and diversity statement.

Disclaimer

It is **your** responsibility to check against the electronic library that this printed out copy is the most recent issue of this document.

Document management

Approval:	Dr.Alex Philpott
Owning department:	KIDS/NTS
Author(s):	Brendan George
Pharmacist:	n/a
File name:	Leonie plus Transport ventilators: set up and usage instructions
Supersedes:	n/a (new document)
Version number:	Version 1	Review date:	
Local reference:		Media ID:	

Additional Notes

The current default setting of the Pmax on your devices is 20 mbar, this can be set from 10-35 mbar.

The Pmax is the maximum pressure the effective pressure (Peff) can reach in order to achieve the set flow and will depend on the size of cannula used, the set flow and the patient.

For example, the effective pressure (Peff) needed to obtain a set flow of 8 L/min through an open cannula varies on the cannula size:
X Large #4 (max flow 27 L/min) @ 8 L/min = Peff 2.8 mbar
Large #3 (max flow 23 L/min) @ 8 L/min = Peff 4.3 mbar
Medium #2 (max flow 14 L/min) @ 8 L/min = Peff 11.0 mbar
Small #1 (max flow 10 L/min) @ 8 L/min = Peff 14.1 mbar

A Pmax setting of 20 mbar would be a good starting point however if you find the pressure release valve is opening too easily with the small sizes, this can be adjusted